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AUTHOR Hanley, Tom V., Ed.; And Others
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ABSTRACT

Ten information bulletins on the implementation of microcomputers in special education are presented. Topics covered include the following: (1) implementation issues (including a description of a study assessing microcomputer applications in 12 local school districts' special education programs); (2) implementation strategies (which focuses on seven major elements, including acquiring microcomputers on an incremental basis, starting with simple approaches, and appointing a microcomputer coordinator); (3) special education applications (instructional, administrative, and impairment compensation applications); (4) introduction of microcomputers in the schools (hardware/software selection, microcomputer location and sharing); (5) coordination of administrative and instructional applications; (6) collaboration between regular and special education (effects and possible problems in cooperation); (7) emerging staff roles for microcomputer implementation (coordinator responsibilities); (8) training teachers and administrators (rationale, strategies, inservice content); (9) relationship of mainframes, microcomputers and minicomputers (advantages and disadvantages); and (10) supervision of microcomputers in the schools (centralized vs. decentralized). (CL)

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MICROCOMPUTERS IN THE SCHOOLS-- IMPLEMENTATION IN SPECIAL EDUCATION

MICROSPED

INFORMATION BULLETIN

Issues 1-10

1984

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MICROSPED Information Bulletin

Issue

1 Implementation issues

2 Implementation strategies

3 Special education applications of microcomputers

4 Microcomputers in schools

5 Administrative and instructional applications:
Competitive or complementary?

6 Microcomputers for special and regular education:
Collaboration or competition?

7 Emerging staff roles for microcomputer implementation

8 Training for microcomputer implementation

9 Microcomputers, minicomputers, and mainframes:
How do they relate?

10 Supervising microcomputers in the schools:
From the top down--
Or from the bottom up?

Contributors to this series:

Margaret R. Brandis, Copy Editor
Laura S. Clark
Tom V. Hanley, Editor-in-chief
J. Lynne White
Robert K. Yin

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SRA Technologies
901 S. Highland Street, Arlington, VA 22204 703-486-0600
Suite 610, 2570 West El Camino Real, Mountain View, CA 94040

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EDITOR'S NOTE

Special educators who want to use microcomputers in their programs can learn from the experiences of others. In many locations across the country, special educators have been very instrumental in implementing microcomputer applications in the schools. Special education teachers have used microcomputers to provide computer-assisted instruction (CAI), computer-managed instruction (CMI), and communication aids with handicapped students. Administrators have used microcomputers to support record-keeping and reporting tasks associated with the requirements of federal and state regulations.

Recognizing the importance of these developments, the U.S. Department of Education, Special Education Programs (SEP), sponsored a suudy of implementation issues related to the use of microcomputers in special education. Through interviews and observations in local school districts, information was obtained that could help others who are just getting started with this technology, or who are looking for alternative approaches.

One of the products that resulted from this study was a series of ten reports that summarized the principal findings. These reports were issued monthly, from January to October, 1984, as the MICROSPED Information Bulletin. The full series is reprinted here.

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MICROSPED
INFORMATION BULLETIN

No. 1

Microcomputers in Special Education

Implementation Issues

Why study microcomputers in special education?

Special educators who want to use microcomputers in their programs can learn from the experiences of others. In many locations across the country, special educators have been very instrumental in implementing microcomputer applications in the schools. Special education teachers have used microcomputers to provide computer-assisted instruction (CAI), computer-managed instruction (CMI), and communication aids with handicapped students. Administrators have used microcomputers to support record-keeping and reporting tasks associated with the requirements of Public Law 94-142.

Recognizing the importance of these developments, the U.S. Department of Education, Special Education Programs, has sponsored a study of implementation issues related to the use of microcomputers in special education. Through interviews and observations in local school districts, information has been obtained that can be useful to others who are just getting started with this technology, or who are looking for better approaches. This report is an introduction to a series of ten Information Bulletins that will document successes and problems of microcomputer implementation. It is hoped that dissemination of this material will foster replication of the most promising practices and procedures, and will prevent some unnecessary mistakes.

What is the focus of this study?

Using a case study approach, a number of school organization issues that affect the process of microcomputer adoption were examined:

- Collaboration between special and regular education programs -- can both groups share the technology, and what procedures support mutually beneficial usage? When available resources are shared, microcomputer adoption becomes more affordable. Nevertheless, each program may have its own special objectives and the system should be designed and managed to adequately address specific needs.

- Decision-making patterns in different stages of implementation -- who should be involved in planning, adoption, purchase, coordination, training, scheduling, etc.? Many different individuals, including both administrators and teachers, may participate in microcomputer implementation. The roles and activities of each person, as individuals or as members of a group, will affect the implementation process.

- Administrative and instructional uses of microcomputers -- can the microcomputers serve different needs of administrators and teachers? Earlier experiences of school districts with mainframe

computers suggested that administrative applications (such as record-keeping, payroll, and report-generation) were often given higher priority and tended to push the instructional applications off the system. Would this also be the case with microcomputers? Alternately, what procedures and policies can school districts follow to ensure that each type of application receives equitable allocation of the resources?

- Training -- what do special educators need to know, to use microcomputers effectively, how can this information be provided? The introduction of any new technology into the schools turns educators, once again, into "students." Both the nature and the extent of training offered to teachers can vary greatly. The study examined the content and format of different training approaches, and investigated the effect of training on subsequent use of the microcomputers.

- Emerging roles -- what new skills, responsibilities, and opportunities accompany the implementation of microcomputers? Over time, the numbers of microcomputers, users, and applications may increase. With this growth, the requirements for technical knowledge and coordination expand. Local educators begin to shoulder greater responsibility for management of the microcomputer system, either through their own initiatives or as a result of administrative direction.

Each of these key issues provided a framework for the collection of information on the implementation experiences in school districts where microcomputers have been used in special education. The data and findings from this study represent a timely information resource for others who would like to adopt microcomputers to improve their services for handicapped students.

How was the study conducted?

The study was conducted in 12 local school districts that have already implemented microcomputers in their special education programs. The school districts were carefully selected to include a variety of characteristics considered important for the investigation:

- Wide geographic distribution -- case studies were conducted in school districts in Arizona, California, Idaho, Louisiana, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Virginia, and Wyoming.

- Diversity of applications -- across the cases, microcomputers were used for administrative and instructional applications and to provide services to both elementary and secondary students; in each of the districts, special education services were provided to students with a variety of different handicapping conditions.

- History of use -- all the districts had at least one-and-one-half years of microcomputer experience.
- Collaboration -- in some districts the special education applications of microcomputers were independent; in other districts they shared the resources with regular education.

What were the characteristics of the microcomputer systems studied?

A microcomputer is a self-standing, data processing device based on a microprocessor chip. A microcomputer includes, at a minimum, an input media (usually a keyboard) for data entry, a display (usually a video monitor, cathode ray tube -- CRT), a central processing unit (CPU), and some form of permanent memory support (e.g., tape recorder, disc drives, etc.).

A microcomputer "system" in a school district was defined as a set of microcomputers shared by an identifiable group of users. The microcomputers could serve a variety of purposes and specific applications by users could be relatively independent. Nevertheless, the "system" was characterized by the presence of shared decision-making patterns in: initial purchase and adoption; allocation and scheduling of microcomputers; sharing of software; provision of maintenance; and arrangements to provide technical assistance or training to users.

Although more than one microcomputer system was present in some of the studied school districts, the case study investigation focused on the system of microcomputers that was used, at least in part, to support special education services. The type of support was instructional, administrative, or both.

The number of microcomputers present in the systems studied varied from two, in a special education administrative system, to 298, in a district-wide, administrative and instructional system. Three of the systems (one administrative, two instructional) were designed for special education applications only; the other nine included applications for both special and regular education programs.

What applications of microcomputers were made in special education?

Microcomputer uses in special education varied greatly. In some districts, the microcomputer system was fairly limited to a narrowly-defined project; in other districts, teachers and administrators were more free to experiment and initiate new microcomputer-based activities, where they saw the need and the applicability.

In general, the most common instructional use of microcomputers with special education students was for computer-assisted instruction (CAI). This occurred in self-contained classrooms, resources rooms, and, in a few cases, in large computer "labs." Younger students used CAI software to develop primary level academic skills: letter and number recognition, shape and color discrimination. "Drill-and-practice" and educational game software was common.

CAI with older or more advanced special education students emphasized mathematics, reading, and spelling skills. Word processing software was used to improve writing skills and to foster eye-hand coordination. Microcomputers were also used as communication aids. In one district a microcomputer was fitted with a special keyboard grid for a physically impaired student. In another district, microcomputer applications were being developed in the program for students with hearing impairments. In some districts, computer-managed instruction (CMI) was also used in special education, either as an integral part of the CAI effort, or separately to measure student achievement and plan instructional objectives.

For the most part, administrative applications of microcomputers in special education were similar to uses in regular education: recordkeeping and reporting, word processing, inventory, scheduling, etc. Nevertheless, two districts had implemented custom-designed, IEP development and monitoring systems. Many other districts indicated that they were planning or developing microcomputer-based IEP Systems.

What topics will the information bulletins cover?

This bulletin is the first of ten. The other bulletins in the series will each focus on individual issues that arose from the research and represent educators' concerns regarding use of microcomputers in special education:

- Strategies for administrators: managing implementation.
- Special education applications of microcomputers.
- Managing microcomputers in the classroom.
- Balancing instructional and administrative applications: cooperation versus competition.
- Collaboration between special and regular educators in the use of microcomputers.
- New and emerging roles for educators.
- Training educators to use microcomputers effectively.
- Mainframes and microcomputers: choices, decision-making, and coordination.
- Centralized and decentralized implementation strategies: a management issue.

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Information Bulletin No. 1: January 1, 1984

Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN

No. 2

Microcomputers in Special Education

Implementation Strategies

What Is The Implementation Problem?

By now, many school districts and special education programs across the country have acquired microcomputers for their students. However, the decision to acquire (or adopt) microcomputers is but the first step in using them effectively. Districts and schools must still work hard to implement the new technology--i.e., integrating microcomputers into a curriculum--before any learning outcomes can be expected.

Unfortunately, more attention has been devoted, in the past, to questions about initial purchase, acquisition, or adoption; less attention has been given to the implementation phase. Yet, even the best acquisition plans can change, due to unanticipated events during implementation. Sometimes, existing organizational procedures within a district or school will have to be modified.

Implementation can also be the phase when a district or school can experience substantial frustrations. For example, microcomputer installation must be accompanied by staff training, and the appropriate software must be available or the machines may not be used properly. Similarly, some supervisory person may have to monitor the use of the microcomputers, to serve as a trouble-shooter, and even to make quick repairs, if necessary. However, this type of person may not have been identified or be available. When implementation does not proceed smoothly, the initial investments will have been wasted, and the microcomputers (as with many other new educational technologies) may literally end up in a closet.

What Information Will This Bulletin Provide?

This Information Bulletin will outline seven elements of effective implementation strategies. The information is based on the results from 12 case studies of microcomputer use in special education. This Bulletin identifies all of the basic elements, but many of them will be covered in greater detail in subsequent Bulletins.

A key task for every administrator is to translate these elements into the special local setting in which microcomputers are being implemented. Every setting is different, and local educators best understand their own schools and the special needs of their students. Thus, the implementation challenge is to incorporate the elements described below into the specific classroom, school, or district setting in which special education students are to be taught.

What Are the Major Elements of Effective Implementation?

1. Acquire Microcomputers on an Incremental Basis. In every district studied, individual microcomputer units were added to the curriculum over a period of years. This gradual increase in the number of microcomputers helped staff adjust to the varying managerial demands, and avoided problems that could have occurred if training, installation, or initiation of use had been conducted too suddenly.

The strategy of following a gradual increase is possible given the nature of microcomputers -- self-standing, independent computing units. Because each unit is independent, a microcomputer "system" can grow incrementally (in contrast to mainframe or minicomputer systems); administrators should take advantage of this feature.

2. Appoint a Microcomputer Coordinator. Every microcomputer system should have some person who is responsible for administering the microcomputers. District level, and even building level, coordinators were found in many of the successful microcomputer systems that were studied. A coordinator can help in many ways: providing sound advice regarding hardware and software acquisitions; allocating the units to specific classroom or office locations; offering training and technical assistance to users; and maintaining and upgrading the system.

3. Formalize Staff or User Training. Formal staff training was found to be an important facet of the implementation process. Such training is different from the one-on-one technical assistance that every user should receive in learning how to use a microcomputer. For successful implementation throughout a district, training must go beyond this individual technical assistance -- although it, too, must be present.

4. Involve Both Administrators and Teachers in the Implementation Process. The case studies found different patterns of participation in the school districts, but the more successfull systems all had participation by both administrative and teaching personnel. When both groups work together, classroom needs are represented and district resources are made more accessible; the system grows and applications expand.

5. Make Microcomputer Applications Work Early; Start with Simple Approaches. Microcomputers can be used in such a variety of ways that administrators may be tempted to design complex arrangements that are difficult to implement. An alternative strategy, followed in most of the case studies, is to start with some simple applications and make them work early. This initial success will generate increased interest and support for the microcomputers, and may also silence potential critics.

There are several ways to encourage early use. First, regardless of the broader curriculum plan, the initial microcomputers may be assigned to the most avid enthusiasts--e.g., teachers who already have learned a little about microcomputers on their own and who can make immediate use of the new machine. Second, the microcomputers can be acquired at the end of the spring semester, allowing for some planning time and staff experimentation

over the summer, before school starts again. Third, advanced students--e.g., gifted/talented students from a senior high school--may be engaged in helping to develop software or even to supervise the use of the microcomputers at lower grade levels. Fourth, and most simply, administrators should avoid grandiose plans and move as quickly as possible to get the machines working on some useful activity.

As these early applications are initiated, microcomputer use can gradually be expanded by adding new applications, training more users, assigning the units to different classrooms, or upgrading the units with more hardware and software. But all of these steps should be taken gradually, after some early uses have proven successful.

6. Expand Microcomputer Uses to Include Administrative as well as Instructional Applications. As more microcomputer units are gradually added, a further strategy is to expand the uses to both administrative and instructional applications. This mixed use is an important objective even if the microcomputers were originally used for only administrative or only instructional applications. Making the microcomputers serve both administrators' and teachers' needs wins support for the system from both types of users.

7. Define and Nurture a Microcomputer "System." A district or school usually acquires and implements several microcomputers within the same "system." (A "system" of microcomputers is an organizational, not a technical definition--because decisions are made about the units as a group.) The same system may not only have many different units, but it may also have different brands of hardware. Indeed, this was the prevailing pattern in the case studies.

For implementation, an important principle, at the outset, is to attend to each system of microcomputers independently, even though more than one system may exist. Similarly, the microcomputer system may be managed independently of any existing mainframe or minicomputer systems. Only after the microcomputer system has grown, and some successful applications have been experienced, should questions about a fuller integration (either of all the microcomputers in a district or of all the computer facilities) be considered, if at all.

In the twelve case studies, all but three had more than a single microcomputer system. The coordinator of one system (serving, for example, high school students) was not necessarily involved with some other system (serving special education or, perhaps, elementary school students). The major objective was to ensure that <u>each</u> system was being implemented effectively. As these systems grew, questions concerning their coordination (and potential competition) could be faced. A less effective implementation strategy would have been to attempt to deal with the coordination question any earlier--when judgments about the role and value of each system would have been premature.

What are the Barriers to Effective Implementation?

Implementation will be more effective if the above elements are followed. All of these elements appear to make good sense, leading to an obvious question concerning the reasons why these elements cannot always be incorporated. In fact, several barriers to effective implementation often exist and are worth noting.

Failure to Plan for Implementation. Good implementation usually requires a modest degree of planning. Different events must be orchestrated, some new resources may have to be found, and some type of system must provide monitoring and feedback information about implementation progress. Unfortunately, some districts spend an exhaustive effort in making the initial acquisitions, but overlook the planning needed for implementation. One way of facilitating such planning is to make reviews of microcomputer use part of the annual budgetary cycles. This will facilitate discussions about the ongoing microcomputer experience and can lead to more informed decisions about use of the microcomputers.

Failure to Establish an Implementation Team. Effective implementation, documented in the case studies, depended upon the presence of a small "implementation team," often collaborating informally. The implementation team was often different from the "adoption group"--frequently larger in size--involved in the initial decision to purchase the microcomputers. Members of the team had two key characteristics--knowledge of teaching needs and access to administrative resources. The main purpose of such a team is to foster smooth implementation. The team therefore consists of the trouble-shooters and problem-solvers. For instance, if a teacher has forgotten how to accomplish a particular microcomputer operation, some member of the team should be able to answer the inevitiable question.

Identify Additional Human Resources. Traditionally, computer use has been seen as a substitute for human resources in educational settings. Whether this outcome is true or not, however, is debatable. Regardless, the implementation phase may require more human resources--e.g., parent volunteers, paraprofessionals, and graduate students--to work with the students who are using microcomputers. One final barrier to effective implementation, therefore, is the failure to identify such resources or to take advantage of them throughout the implementation process.

Next in this series: "Special Education Applications of Microcomputers."

Information Bulletin No. 2: February 1, 1984

Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN

No. 3

Microcomputers in Special Education

Special Education Applications of Microcomputers

Microcomputers are very flexible devices. Their specific use ("application") can vary greatly from one setting to another. In spring of 1983, case studies were conducted in 12 school districts where microcomputers were being used in special education. A variety of applications had been implemented in those districts. Based on information collected in those cases studies, and on recent reports of additional uses that may become more common in the future, this Bulletin examines the types of applications that can be implemented in special education.

What types of microcomputer applications are possible in special education?

It may be argued that each application of a microcomputer is different: even when the hardware and software are the same, variability among users makes the specific application unique. This is a result of the interaction between the microcomputer and the user. Output from the microcomputer reflects, in some manner, the input from the user. To the degree that users vary in the input they provide, and the software is designed to respond differently to varying input, each application will represent a different sequence of events.

Nevertheless, the increasing experience of educators with microcomputers leads to an understanding that there are categories or types of microcomputer applications which are evolving in the schools. On the simplest level, many educators draw an initial distinction between instructional and administrative applications. In special education, both of these broad types have been implemented in the schools, as well as a third type: impairment compensation.

What are "instructional applications"?

When a microcomputer is used to provide or manage direct instruction to a student, that is an instructional application. The goal of instructional applications is to increase the student's cognitive ability. Within the category of instructional applications, there are a number of major subcategories:

- Computer-assisted instruction (CAI). The computer is used to provide direct instruction in traditional educational areas. A key feature of CAI is its focus on the academic skills, rather than on the computer itself. CAI has been the center of much attention in special education, and three general subtypes are often mentioned:

-- "Drill-and-practice": this is the simplest instructional method; items are presented in a quiz-like format and responses are measured (and reinforced) for correctness. Drill-and-practice software is designed to supplement, rather than to replace, instruction.

-- Tutorial: this approach is intended to provide as much of the actual instruction as possible. The student is led through the material in a manner that resembles a normal sequence of instructional steps. One major difference between this and drill-and-practice is that tutorial software presents new material; drill-and-practice does not.

-- Simulation: this method presents the key aspects or elements of an environment to the student and invites the student to participate in decision-making. Via student input, systems of cause and effect are "simulated" by the microcomputer.

Other subtypes have also been proposed, but there are differences of opinion as to what they represent. "Educational games," for example, seem to usually fall into one of the three subcategories defined above, but incorporate a system of controlled rewards to motivate student participation. "Problem-solving," by some definitions, includes use of computer programming or "utilities" software and, therefore, may be considered a form of computer literacy or programming. Alternatively, some educators describe "problem solving" as a tutorial method used in science, English, social studies, and mathematics: the computer presents word problems; the student solves them and, when successful, moves on to the next lesson. Word processing software has been introduced in many classrooms to promote reading, grammar, and composition skills. In special education, word processing is also used to foster attention, eye-hand coordination, and fine motor skills.

- Computer literacy. The computer is used to promote two related objectives: (1) to foster acceptance and understanding of the computer itself; and (2) to demonstrate and teach the student how to use the computer to accomplish real-life tasks.

- Computer programming/science. The focus of learning is on the computer itself: how to control the operation of the microcomputer and how to develop new applications of the technology.

- Computer-managed instruction (CMI). The teacher uses the computer as a management tool to measure, plan, and monitor instruction.

What are "administrative applications"?

In the simplest sense, an administrative application is one performed by or for a school administrator. A school district is an organization and, consequently, the general types of administrative applications in the schools are similar to microcomputer uses in other organizations:

- financial management systems;
- information management systems;
- report preparation (including charts and graphs); and
- word processing and mailing.

Some of the more common applications observed in the 12 case studies included attendance and enrollment systems, inventories of equipment and supplies, schedules, personnel information, and student records. In special education, microcomputers were also used to assemble and manage "child count" data and to develop and monitor Individualized Educational Plans (IEPs).

What are "impairment compensation applications"?

Many researchers and educators are especially excited about the potential value of microprocessor-based technologies to provide prosthetic solutions for specific impairments. In an educational setting, such applications can make it possible for handicapped students to engage more directly in educational programs and, hopefully, to participate more fully in the social mainstream. The applications of microcomputer technology can include: sensory (perceptual) compensation, communication aids, physical control (robotics), personal management, and vocational adaptation and accommodation.

What applications were implemented in the studied school districts?

A variety of applications were implemented in the studied school districts. Three will be briefly described; each represents one of the three broad types described above: instructional, administrative, and impairment compensation.

Computer-assisted instruction: Oakhurst, New Jersey. In a self-contained classroom for young (six and seven year-old) neurologically impaired children, the microcomputer was used to develop simple discrimination and recognition skills. For example, one software program presented sequences of letters from the alphabet. In each presentation, one letter was missing. The student's task was to press the key representing the missing letter. Correct responses were rewarded with a starburst pattern that appeared on the video monitor. Incorrect responses were followed by prompts and an opportunity to try again. After the second error, the program supplied the correct response, and moved on to another letter sequence.

IEP management system: Tallulah, Louisiana. An extensive IEP development, monitoring, and reporting system was coauthored by the district's director of special education and a professional computer programmer. The "special education module" created and maintained student files. Records could be added, deleted, and changed. A variety of reports, such as IEP objectives

and goals, progress evaluations, and school summaries, were generated. In addition, the system also handled general business and accounting for the special education program. The software package was copied and implemented in numerous other school districts.

Communication Aid: Boise, Idaho. The first microcomputer adopted for special education in this district was used to provide communication assistance for a severely impaired (quadriplegic) teen-age girl. The student had limited use of one arm, limited head control, and no speech. The microcomputer was fitted with a special keyboard grid that allowed her to press desired keys. She used the microcomputer both for communication and for some computer-assisted instruction.

What's so special about special education use of microcomputer?

In a majority of the districts that were studied, special and regular education programs shared the microcomputers. Regular and special education teachers received the same inservice training and many of the applications were similar for both groups of users.

However, as the examples above indicate, microcomputers provide solutions that offer particular usefulness in special education. In the second and third examples--the IEP and the communication applications--the relevance to special education is clear. In the first--CAI in primary-level letter discrimination--the software could be used with either regular or special education students. Nevertheless, as many special education teachers pointed out, this type of use was particularly beneficial with their students:

- The software, especially if it contained a "game" element, was very effective in attracting and maintaining the student's attention.
- For unknown reasons, the students find the "corrections" from the machine to be non-threatening. They can make mistakes, but move right on and try again without the experience of "failure."
- In special education classrooms, the available microcomputers will help keep some students occupied--allowing the teacher to work more individually with other students who are not using the microcomputers at the time.

These are additional, incidental factors that special education teachers mentioned as reasons for their acceptance of the technology.

The next Bulletin in this series will focus on "Microcomputers in the School."

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Information Bulletin No. 3: March 1, 1984

Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED INFORMATION BULLETIN | No. 4 | Microcomputers in Special Education

Microcomputers in the Schools

This issue of MICROSPED Information Bulletin focuses on the introduction of microcomputers into schools and classrooms. The information reported here is derived from case studies of 12 school districts where microcomputers are used in special education.

What steps are necessary before microcomputers are placed in the school?

Whether or not microcomputers are already present in a school, it is essential to plan ahead for any new microcomputers that will be installed. Some of the decisions that need to be made are:

- How will each microcomputer be used?
- Who is going to use it?
- What kind of hardware and software is required?
- What local funds and resources are available?
- Where will the microcomputer be located?
- What are the needs for training?

In general, an understanding of how the microcomputer will be used presents a fabric for all the other decisions. Planning the initial applications -- particularly in a school with little or no prior experience with microcomputers -- is very important. Early success with the technology will encourage teachers to become more involved and will provide experiences that can be imitated by others.

Who should be involved in determining initial use?

For instructional applications of microcomputers, both teachers and administrators should share in the decision-making process. Early participation by teachers accomplishes two things: (1) it ensures that the microcomputers will serve teachers' perceived instructional needs; and (2) it serves to identify the teachers who are most interested and will make the best candidates for initial applications.

Participation by administrators, such as principals, will foster their support for the use of microcomputers. This support is critical for initial and continuing funding, and is also a key factor in timely allocation of other resources -- funding and staff time for training programs, classroom or "lab" space, scheduling and management of the microcomputer system, establishment of software libraries, etc.

The planning team should also include someone with experience and knowledge about microcomputers. If no one in the school has such a background, technical advice should be sought from someone outside the school.

How should hardware and software be selected?

The initial plan for microcomputer use will help determine the equipment that should be purchased. Software is a key consideration. The type of application planned (drill-and-practice, tutorial, etc.), the content area (arithmetic, English, social studies, etc.), and the ability range of the students must all be considered.

If local staff are not familiar with software products, they should seek out -- from other schools, districts, colleges, educational journals and magazines -- the opinions of educators who have had experience with educational "courseware." Once appropriate software has been identified, then the selection of hardware can be made: the hardware will be that which runs the identified software -- plus a range of other software, to allow for future growth in applications. If more than one brand of hardware meets that requirement, then consider factors such as price, local repair and technical services. Within budget constraints, also consider the cost and usefulness of peripheral devices. With most educational applications, at least one printer (it can be shared by a number of microcomputers) is required. Disk drives, if they can be afforded, greatly simplify and speed up the tasks of loading, running, and saving programs and data.

Which teachers should be allocated microcomputers?

Microcomputers, especially the first units introduced in a school, should be provided only to those teachers who have indicated interest in using this technology and who have some concrete plans and objectives. Further, all such teachers should receive some preliminary training, including "hands-on" experience, in using the microcomputers. This could occur in an inservice training program if one is already operating in the district, even if it occurs at another school that has had more experience with microcomputers. If no training opportunities are available in the district, selected teachers may be sent to training sessions in other districts, or at local colleges, conferences, or commercially sponsored training centers. (Planning for microcomputer introduction must consider that resources will have to be allocated to meet the teachers' needs for training.)

Where should the microcomputers be located?

There are two general rules governing microcomputer location:

1. The location should be easily accessible to those who intend to use the microcomputer.
2. The location and activity should not present a distraction to others who are engaged in non-computer-related activities.

When microcomputers are placed in classrooms, steps should be taken to reduce interference with other class activities. If the classroom is large enough, a section can be set off as a microcomputer area. If possible, room dividers (e.g., large bookcases) may be installed to provide more shielding between the different activities.

Placement of microcomputers in classrooms assumes that there are enough microcomputers to go around to satisfy the needs of all the teachers. Often, this is not the case. When demand outstrips the availability of equipment, microcomputers are placed in alternative locations.

In the case studies of 12 school districts, microcomputers were found in a variety of non-classroom settings: in hallways, computer labs, offices, libraries, media centers, cloak rooms, and on moveable carts. In a few school districts, large computer labs were set up for numerous microcomputers, furniture designed or tailored to the microcomputer use, and software organized for easy access and storage. These larger settings also permitted a full class of students to be using the computer at the same time; the teacher could move about the room providing individualized assistance.

How can microcomputers be shared?

Since most instructional microcomputers will be used by students and teachers from more than one classroom, it is important to establish guidelines, responsibilities, and schedules for shared usage. The first step in successful sharing is to make one person clearly responsible for the microcomputer. In a school where there are only a few microcomputers and they are placed in classrooms, the classroom teacher is often responsible for each unit. In a larger microcomputer system, one person (or a small group of persons) should be given the responsibility to coordinate the use of the microcomputers.

In many of the visited school districts, sign-up sheets were a common method used to reserve use of the microcomputers. In schools with large computer labs, formal schedules, agreed upon by the teachers, were established for use of the microcomputers.

What about the microcomputer workstation itself?

Whether the microcomputer is located in a classroom or in a computer center, the same sets of features contribute to a supportive environment.

- The keyboard and monitor should be set on a table (or other platform) that will allow the student to enter keystrokes at an appropriate height and will provide easy viewing of the video monitor. NOTE: Some adjustments will be required if smaller and larger students are both using the same workstation.
- There should be some space alongside or in front of the microcomputer for papers and books. Students will often need to take notes or have reading material with them when they use the microcomputer.
- Software (discs, cassettes) and any necessary documentation should be conviently located and organized. Students should be instructed in how to find the software and, subsequently, how to replace it so the next user will also be able to access it.
- It is a very good idea to have signs prominently posted around the workstation, describing some of the key steps in operating the microcomputer (e.g., "How to load a program: Step 1..") and warning about possible problems (e.g., "Be sure to remove your diskette when you are finished and put it back where it came from!", "Don't POUND on the keys!")

More than one student can be assigned to a microcomputer at a time. Two students can sit in front of the terminal, even if only one is using the keyboard; they can take turns. This process was observed in many districts

and seemed to work well, especially with younger students. When the courseware has a game element, the students tend to help one another and also learn from each other's mistakes.

What are some of the problem areas and what can be done about them?

Underutilization -- This can occur for a number of reasons: lack of interest by teachers who were assigned the microcomputers, inadequate or faulty software, insufficient training, placement (inconvenient or inaccessible) of the units. In each case, the specific problem should be identified and the logical solution implemented: reassignment, more or better quality software, training, relocation of the units. When possible, more experienced users should be encouraged to provide technical assistance to teachers who are experiencing difficulties.

Maintenance -- Microcomputers are remarkably reliable machines. Very few technical problems were reported in the 12 districts that were studied. Nevertheless, problems can occur and when they do it is important to provide timely and effective repairs. Quite often, experienced microcomputer users in a school district (including students) can be called upon to correct the problem. If that is not possible, a nearby service (such as a local computer store) should be called upon for needed repairs. Avoid expensive service agreements with dealers and manufacturers. Most microcomputers come with an initial warranty. If there are major problems, they will usually be noted during the period covered.

Software -- This is a key area of concern for many educators who are just beginning to use microcomputers. Unfortunately, there are no easy solutions -- printed descriptions of software can be very deceptive; first-hand experience is the best criteria for selection. Consequently:

1. Whenever possible, try to get information from teachers who have already used software products. Their experience with the product is the best guidance for making a decision.
2. INSIST ON THE RIGHT TO REVIEW ALL EDUCATIONAL PRODUCTS BEFORE PURCHASE. The great majority of reputable software suppliers have a review policy (usually 30 days) on their products. Take this opportunity and do not pay for any software until the product has been tested out in the classroom.

Another software resource that can be tapped in some districts is teachers and students who have developed good programming skills. Sometimes these individuals will be able to modify existing software and make it work better or more appropriately, or to develop special software that is otherwise not available. Note, however, that large-scale, "home-made" software development is generally not efficient, when suitable (and usually better) commercial software can be obtained.

Next in this series: Balancing instructional and administrative applications -- cooperation or competition?

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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INFORMATION BULLETIN

No. 5

Microcomputers in Special Education

Administrative and Instructional Applications: Competitive or Complementary?

A common debate is whether administrative applications tend to compete with or complement the instructional ones. Some people view administrative uses as eventually dominating a computer system and displacing the instructional applications. Others feel that the addition of administrative applications can lead to the more successful implementation of a computer system, with more resources eventually being allocated to both types of uses. Thus, the balance of resources between these two types of applications can affect the growth and stability of the entire system.

This bulletin will focus on how both instructional and administrative applications can exist within the same microcomputer system. There are lessons that can be learned on the ways these two types of applications can complement each other, as well as strategies to be followed in implementing and managing these separate applications.

The information for this bulletin is based on case studies conducted in 12 school districts where microcomputers were being used in special education. The school districts were deliberately selected to represent cases where microcomputers were used for administrative applications only, instructional applications only, or for both types of uses. The three types of uses were compared over time--i.e., to see whether there was any evidence that the administrative applications were displacing instructional ones, or whether they were producing increased support for the entire microcomputer system.

How Are Instructional and Administrative Applications Defined?

In each school district, the extent to which microcomputers were used for instructional or administrative purposes was first determined. Thus, the major applications for each microcomputer were enumerated and identified as being either instructional or administrative based on the following:

- the subject matter;
- the dominant type of users;
- the proportion of microcomputer hours used; and
- the name and type of software.

The following is a list of instructional applications commonly found in the school districts:

- computer literacy
- computer programming
- word processing
- computer-assisted instruction
- computer-managed instruction

Administrative applications in the school districts were at both the district and school building levels and included the following:

- student scheduling
- grade reporting
- attendance reporting
- test score data
- student information records
- payroll preparation
- accounting and budgets
- personnel files
- education report production
- Individualized Education Plans (IEP) development and monitoring

What Determines the Initial Use of Microcomputers?

Decisions made in the planning stages for the microcomputer system determined the initial pattern of microcomputer use for either instructional or administrative applications. In the 12 case studies some of the decisions that were addressed in prioritizing the microcomputers for either use were:

- the physical location of the microcomputers (classrooms, district offices, school administrative offices);
- accessibility of the microcomputers to administrative staff and teaching staff;
- the allocation of hardware resources;
- scheduling of microcomputer time; and
- the acquisition of software.

In most school districts with only instructional microcomputers, teachers or building administrators were the initial users. Usually these persons became interested in the instructional potential of microcomputers on their own and acquired a unit in their classroom or school. This initial interest then set the pattern and direction for other teachers to acquire microcomputers for instructional use. Only later in the process did

district administrators become involved in microcomputer use, based on teachers' or principals' requests for equipment, and needs for technical assistance and training.

Alternatively, there were school districts where district administrators served as the impetus for adopting microcomputers. In these cases, district administrators secured funding and resources for acquiring the microcomputers and software incrementally, or made bulk purchases of units and distributed them to schools or individual teachers based on interest and experience. In one school district, microcomputers were allocated to teachers only after the teachers had demonstrated how they would use the microcomputers. In another school district, teachers received microcomputers only after completing a training course on computer operations.

In school districts where microcomputers were used for both administrative and instructional applications, the mixed usage was determined in the initial planning stages. The initial adopter or planning group investigated both types of microcomputer uses. This was then reflected in the initial purchasing and allocation decisions. The first microcomputers were allocated specifically for either instructional or administrative use, and resources for software were made available to support the application.

How Did Initial Patterns of Use Change Over Time?

During later stages of implementation progress, a microcomputer system may expand from its initial pattern of use to include other types of applications. In the 12 case studies, expansion from instructional-only or administrative-only microcomputer use to mixed uses was a common direction of growth for microcomputer systems. In nine school districts with microcomputers initially devoted to instructional uses only, five later expanded to include administrative applications. In none of the 12 school districts had administrative applications dominated or displaced instructional ones.

In fact, the potential relationship between the two types of applications appears to be a positive one. A microcomputer system with both uses does not guarantee implementation progress, but it does seem to be an important factor in the continued growth and success of microcomputer use in a school district. In the 12 school districts studied, neither instructional-only nor administrative-only systems had grown and expanded as readily as mixed systems. The mixed systems tended to produce the needed dual support and interest for both instructional and administrative applications.

For example, in four microcomputer systems that began as instructional only but later became mixed, one or more microcomputers were allocated to a district-level or principal's office for administrative purposes. These administrators served as strong supporters of microcomputer use, which helped the usage to expand. In one school district, dual support resulted in two new positions--one to concentrate on instructional applications and the other to assist the implementation of administrative ones.

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In contrast, in school districts where microcomputer use had remained instructional, or administrative-only, the microcomputer systems had not expanded in either applications or additional units beyond the original implementation. There seems to be a potential vulnerability of systems dedicated to only one use due to staff turnover, imbalanced allocation of resources, and lack of continued interest.

How Can Instructional and Administrative Use be Coordinated?

To the extent that both instructional and administrative applications are to exist in the same microcomputer system, different coordination strategies and procedures can be used to manage both types of applications.

1. There is no one clear advantage between allocating separate units to the two types of applications and using the same microcomputers for both administrative and instructional use. Both coordination strategies have resulted in similar growth and stability of the microcomputer systems.

2. Avoiding competition between the two types of uses can be achieved by providing sufficient resources for purchasing hardware and software and for training both teachers and administrators to support both types of applications.

3. Where units are shared for both types of uses, the administrative use can be scheduled at times when there is no instructional use.

4. The ability to purchase microcomputers incrementally allows for the acquisition of additional units when either instructional or administrative use reaches a level where competition could arise with other applications. This feature may be different than that possible with the more traditional mini- and mainframe computers.

Next in this series: Collaboration between regular and special educators in the use of microcomputers.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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INFORMATION BULLETIN

No. 6

Microcomputers in Special Education

Microcomputers for Special and Regular Education -- Collaboration or Competition?

A key question to ask when planning microcomputer use is --

> Does special education need its own system of microcomputers, or can special education applications be integrated with other microcomputer applications in the school district?

When available resources are shared, microcomputer adoption becomes, for one thing, more affordable. However, each educational program in a school or district has its own objectives. A shared microcomputer system should be designed and managed to fairly address the particular needs of different users.

What is the Evidence on Shared Usage?

Case studies were conducted in 12 school districts where microcomputers have been used in special education. One of the factors considered during selection of the case study sites was whether or not regular and special education programs shared their microcomputers. Preliminary information (prior to the site visits) suggested that only half the sites included shared microcomputer systems. The eventual case studies, however, disclosed that over time most of the school districts had developed collaborative patterns for use of the microcomputers. Only three (of the twelve) microcomputer systems remained restricted solely to special education use.

Participants in Initial Adoption of Microcomputers

Microcomputer use, especially for instructional applications, was often a "bottom-up" rather than a "top-down" process. The initial user was often a teacher, operating in relative isolation from district-level administration. This was true for both special and regular education instructional applications. In some cases, teachers actually purchased the first microcomputers with their own personal funds, or the equipment was donated by private groups--parents' associations, advocacy groups, etc. In a few cases, bake-sales or other fund-raising activities were conducted to purchase the initial microcomputer(s).

As the number of microcomputers increased, administrators came to play a more direct role in their purchase, allocation, and management. In fact, general (not special education) district-level administration came to exert a key "centralizing" influence over microcomputer use in a majority of the districts studied.

In contrast, special education administration was not as directly involved--neither in initial planning and adoption, nor in subsequent management of the instructional applications. There were a number of possible reasons for this:

- Special education administrative staff were relatively few in number and their time was heavily allocated to other tasks: assessment, placement, records and reports, etc.
- The impetus for instructional applications came from special education teachers. When special education administrators became involved, they were usually more interested in administrative applications of microcomputers (such as for IEP's and "child count" data).
- In an atmosphere of reduced local budgets and increasing demands for services, special education administrators were often reluctant to provide funds for purchase of microcomputer equipment.

Consequently, special education teachers relied on equipment purchased or provided with other resources. In using this equipment, the teachers interacted more often with general staff (regular education teachers, administrators, and microcomputer coordinators) than with special education administration.

Later Collaborative Patterns

Absence of special education administrative involvement did not prevent special education teachers from using the microcomputers. In nine (out of twelve) districts, special education teachers and students used equipment and software that was also used by regular education. Special education shared the microcomputer resources with computer literacy and programming courses, remedial and Title I classes, gifted and talented programs, and other elementary and secondary programs in a variety of academic areas. Following the initial purchase and adoption of microcomputers, most collaboration occurred at the school building level--between teachers, principals, and school microcomputer coordinators. In a number of schools, special education teachers (or former teachers) served "coordinator" roles for the microcomputer applications.

What Were the Effects of Collaboration?

Many elements of collaboration seemed to have a positive impact. The growth of microcomputer use was strongest in schools and districts where regular and special education shared the equipment. Teachers from the different programs were engaged in more interdisciplinary interaction. Some special education teachers felt that this sharing reduced their isolation from other school staff.

Similarly, some special educators also credited collaboration with improvements in communication and socialization between special education students and their non-handicapped peers. In one district, they coined the term "reverse mainstreaming." During the initial adoption of microcomputers, special education staff and students had first priority on the equipment. Now that regular education was beginning to use the microcomputers, special education staff and students were in a position to "show them the ropes." Regular students would sometimes come into the special education classrooms to use the microcomputers. Handicapped students would tutor them and introduce them to basic applications--operating the hardware, loading and running programs. This, the teachers felt, improved the students' confidence and sense of self-esteem.

Further, when members of different groups collaborated, the numbers of users and units grew. This increased the availability of resources (human and material) for everyone in the system. Special educators used software that had been purchased for regular education classes, and vice versa. Inservice training and technical assistance activities were shared across staff from the different areas. Users' groups and coordination groups in the schools included both regular and special education participants.

What are the Possible Problems in Collaboration?

There are two principal areas where problems can develop. The first relates to the process of collaboration--is the system designed so each user gets a fair share of the resources? The second problem area relates to the nature of the application--does collaboration dilute the special usefulness or effectiveness of the microcomputers for specific groups?

Regarding the process of collaboration, the findings were very positive. Special educators were generally satisfied that they were receiving a fair share of the resources. A variety of procedures were implemented in the districts to ensure equitable distribution. In some cases, microcomputers that were purchased with special education funds were clearly marked. In one "computer lab" setting, each unit was stenciled, in large block letters, indicating the source of its purchase. This served as a reminder to all that special education (and other discretionary program funds) had made this equipment available. Those who were responsible for scheduling or coordinating the use of the equipment kept this factor in mind. They made sure that the program areas that provided the equipment had first priority usage.

Additionally, in all districts that shared the equipment, there was an understanding that it was in everyone's best interest to cooperate fairly in allocation of the resources. This sense of cooperation was seen as crucial to winning continuing administrative (e.g., principals') support for expansion of the microcomputer systems.

Regarding the second issue--the nature of the microcomputer applications--the findings may not have been quite as satisfying. Although there were some notable exceptions, most of the instructional applications in special education were limited to very simple "drill-and-practice" exercises. Special educators, however, did attribute a number of extra benefits to this type of computer-assisted instruction when used with handicapped students:

- In some cases, handicapped students do need more practice on lessons than do their non-handicapped peers.
- The reinforcers built into many "drill-and-practice" exercises, and the nonthreatening correction provided with this software, are successful activities to get the students to do more than they would (with workbooks, for example).
- CAI "drill-and-practice" exercises have an additional, classroom-management benefit. While some students are working on the computer, the teacher is freed-up to provide individualized intruction to other students.

Nonetheless, members of the research team were disappointed at not finding more examples of innovative use of microcomputers or applications that were more specifically linked to the particular needs of handicapped students.

What Can be Done to Improve the Usefulness of Microcomputers in Special Education?

As the above example demonstrates, microcomputer applications of greater specific value to handicapped children are possible. They do, however, require more planning and the provision of specialized technical assistance and training for the teachers. All too often, it seemed that special education teachers simply adopted what was already available (hardware and software) in the school. Special education will have to, it would seem, play a more active role in determining the applications and preparing staff to use the microcomputers.

Along these lines, special education administrators should become more involved in planning and decision-making regarding the microcomputers. Working with teachers who are familiar with the technology, efforts should be made to identify and acquire software that is more appropriate and instructionally sound.

A key step in this process would be to provide inservice training that emphasizes the elements of good instructional software that contribute to appropriate, individualized learning for each student. Because these elements are useful for instruction of both regular and exceptional children, it may not be necessary to establish separate training for special educators. Nevertheless, special education administration should see to it that these features are incorporated in the training that staff receive.

Finally, attempts should be made to identify innovative and more specialized applications of microcomputers that have particular value for students with specific physical, sensory, or communication handicaps. As special educators become more knowledgeable about microcomputer-based devices and peripherals, efforts should be made to introduce these developments into school districts. Many of these impairment-compensation devices will increase the ability of handicapped students to receive appropriate instruction in less restrictive settings.

In summary, the research disclosed that special and regular education can work cooperatively to introduce this technology in the schools. At this point in time, the nature of instructional applications is limited by the recency of this technological innovation--both for regular and special educators. As time goes on, greater usefulness and sophistication in microcomputer applications will occur as educators and administrators play a more proactive role in planning and managing microcomputer use.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN

No. 7

Microcomputers in Special Education

Emerging Staff Roles for Microcomputer Implementation

The increase in numbers of microcomputers and the growing diversity of their educational application create a need for conscious management of microcomputers in a school district. Such management entails the coordination and administration of daily activities and decisions regarding planning, design of applications, and microcomputer use. Specific activities include:

- purchasing and allocating microcomputers;
- reviewing, purchasing and distributing software;
- maintaining a central file/catalogue of software;
- scheduling and planning computer use; and
- scheduling and providing training and technical assistance.

This bulletin will focus on the emergence of microcomputer specialists and coordinators in school districts to satisfy these management requirements. The report describes the new skills and responsibilities required of special education staff whose districts have implemented microcomputers, and strategies districts can use to coordinate their microcomputer systems.

The information in this bulletin is based on case studies conducted in 12 school districts where microcomputers were being used in special education. The coordination patterns in each district were documented to determine the extent to which new organizational roles were created or adapted for managing the microcomputers. Individuals and groups who performed coordination functions were identified and their roles were examined.

Different Coordination Patterns Emerged

As schools acquired more microcomputers and software, and as the number of users and applications increased, the need arose for someone to manage equipment and serve as technical resource to staff. The case studies disclosed that in each district one or a few key individuals played major roles in adopting and advancing microcomputer use in the schools. At least one person served, in some way, as coordinator for the microcomputers. In some cases this role was formalized by administrators with a position statement or title. These coordinators were explicitly authorized to manage the microcomputers throughout the district or in particular schools. In cases where the person was not officially designated by administrators, this role was filled in an informal manner. These unofficial coordinators might only serve as a resource in specific school buildings or, depending upon other obligations, provide technical assistance throughout the district.

A teacher or administrator might assume additional microcomputer coordination responsibilities along with current duties; in these instances the new role was an alteration of a previous position. In other cases, an entirely new staff position was created; the coordinator would then work part-time or full-time in this role.

Some districts established planning teams that managed decisions regarding implementation of microcomputers. In such cases, a combination of management patterns coexisted: decisions would be made at the district level regarding purchases and funding while teachers and principals at the school level would determine actual use of the microcomputers as well as purchase, distribute, and maintain a software catalogue.

Appoint a Coordinator

A critical management strategy was to appoint a microcomputer coordinator. Ideally, a coordinator would be designated early in the implementation process to ensure continuity within the school district and therefore conserve dollars, time and effort. The coordinator would help by:

- providing sound advice regarding hardware and software acquisitions;
- allocating units to specific classrooms or office locations;
- offering training and technical assistance to teachers; and
- maintaining and upgrading the system.

Given these responsibilities, the coordinator should be someone who had experience with and an understanding of microcomputer applications in education.

The same person or group that had initiated or adopted the first microcomputers in a school district would be strong candidates for the coordinators' role. These candidates typically would possess microcomputer expertise as well as familiarity with the equipment used in the district. Former or current teaching experience would provide a better understanding of the needs of the teaching staff. If the coordinator would be in charge of purchasing and allocating equipment, then he or she should have that authority or at least the ability to solicit administrative support. As the microcomputer system expanded, the coordinator might need to reduce his or her direct teaching duties and increase management responsibilities.

In six of the twelve districts visited, the coordinators (formal or informal) came from the ranks of special education--they were currently or had formerly been special education teachers. This special education representation in management decisions was helpful in meeting special populations needs: in identifying appropriate software, planning appropriate inservice training, and providing technical assistance regarding specialized equipment.

Examples of Coordinator Responsibilities

Whether the coordination activities were conducted by a single individual or a planning group, the responsibilities were similar. In general the coordinator must address decisions regarding:

- acquisition, allocation and distribution of microcomputers;
- maintenance and upkeep;
- trouble shooting;
- technical assistance and training;
- software development, selection, evaluation and storage; and
- planning applications and scheduling microcomputer use.

The following are examples (from the case studies) of coordinators' functions in districts where these roles were either formally or informally designated.

In a one-school vocational and technical education district, the superintendent appointed a special education resource teacher to the position of microcomputer master teacher. This new role required the special education teacher to add coordination of the microcomputers in the computer lab to his regular teaching responsibilities. He was in charge of providing inservice training, maintaining equipment, and serving as a resource to the staff. A second person in this same district was designated the microcomputer specialist and was responsible for scheduling and managing the use of the other computers in the district. He also maintained the district's software library.

In a larger, suburban school district (6,900 students), a variety of roles for managing the microcomputers emerged. A formal coordination group at the district level was responsible for the development of instructional and administrative applications, inservice training, maintenance and use of computers, and coordination and compilation of software. However, the media specialists in each school building maintained the in-house software collections, provided technical assistance and managed school-based applications of the computers. By the first year of implementation three full- time positions to manage district's microcomputers had been established: a data processing/dissemination specialist, a programmer analyst consultant, and an instructional computer consultant who supervised the media specialists in each school.

In a similar district, a special education resource teacher took on a newly created role of part-time computer curriculum specialist. Her responsibilities included developing educational computer programs, designing staff development activities, coordinating use of equipment, and preparing budgets and purchase orders for the director of special education. She also developed and implemented pilot demonstrations of new microcomputer applications in the classrooms.

Typically, in districts without an official computer coordinator, early microcomputer enthusiasts were a resource to new users and continued to be approached informally by teachers and administrators for ongoing technical assistance. In a large urban school district, purchases of microcomputers and design of applications were conducted independently within schools. The microcomputers were assigned to teachers who had requested them. The first microcomputer was acquired by one of the special education consulting teachers and, subsequently, he considered microcomputer assistance part of his support role. He offered suggestions on using the equipment, transported computers between buildings, and trained teachers for new applications. He advised teachers on the suitability of particular software and distributed software as needs arose.

A large, rural northwestern school district had established various informal coordination committees over the early history of microcomputer implementation in the district. User groups emerged that were specific to particular hardware brands. These provided support and some training for teachers. Excessive variation in purchasing and allocation policies, however, led to problems of incompatibility. This prompted the district administration to step in and place a freeze on additional purchases until more comprehensive coordination could be established.

Problems to Avoid

Lack of coordination led to problems that could impede effective use of the microcomputers. Without monitoring, direction, or guidance from a coordinator, users operated independently of each other. Lack of communication could result in isolated purchases and duplicated costs. People who were unaware of applications within their buildings, or across the district, did not benefit from the shared experiences of others. Increasing diversity in the types of computers purchased also led to incompatibility of software, and limited sharing and more efficient use of the computers.

Appointing a temporary coordinator--such as only for the duration of special projects--might inhibit subsequent growth of the microcomputer system. Some districts adopted initial microcomputers through grants which specifically stipulated how the microcomputers were to be used. A coordinator was then designated for the duration of the project only. It would have been helpful for districts to actively maintain this position beyond the grant period to insure continuity of use and smoother transition from project to general use. For example, one district terminated the coordinator position at the completion of a federal project. Staff reported that without the continued management and technical assistance provided by the coordinator, the units were unused, or were only used in the limited manner originally specified by the grant.

When the coordinator was the primary user, a coordination team might be preferred. In districts implementing predominantly administrative applications, the primary users might be limited to the few staff located in district offices. When others weren't familiar with the units or applications, the entire system became vulnerable to staff turnover. A coordination team would help maintain continuity should the primary user leave the district.

Rapid growth without effective management might lead to inefficient use or idle microcomputers, so coordinators should be familiar with and keep pace with the growth of the microcomputer system throughout the district. They should be aware of all types of hardware used in the district and should arrange technical assistance activities compatable with equipment. Training opportunities and scheduling should accompany new purchases and increases in users.

The responsibilities of the coordinator and/or members of the coordination team should be clearly designated so there is no confusion over whom to turn to when in need of help. One person may be instrumental in allocating funds for the acquisition of units, another in set-up and installation, a third in review, evaluation and cataloging of software. Whatever the division of expertise, staff should know where to go for technical assistance.

Next in this series: Training Strategies for Microcomputer Implementation.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN
No. 8
Microcomputers in Special Education

Training for Microcomputer Implementation

For educators to be able to use a microcomputer effectively they must know how to operate it; how to select, evaluate and run software; and how to integrate the technology into the school system. New users of the microcomputer system require training if the units are to be used to their full extent. Training opportunities are essential, not only for successful implementation, but also for subsequent growth of the microcomputer system.

This Bulletin will focus on the relationship between the progress of microcomputer implementation in school districts and the availability of training opportunities for educators and administrators. Examples of training approaches observed in school districts will be described. The information in this Bulletin is based on case studies conducted in 12 school districts where microcomputers were being used in special education. The research investigated the type and nature of training opportunities available for teachers and administrators during the implementation of the microcomputer systems.

For the purposes of this study, training was defined as organized, inservice, group instruction. This definition of training included "multiplier" approaches where individuals trained were required to train others. Totally individualized instruction, however, such as one-to-one technical assistance, was not considered training. The growth of the system was defined as the rate of increase in users and units, expansion of applications, and diversification and efficiency of microcomputer use. The case studies examined training activities for planners and users of microcomputer systems in all stages of implementation. The level of available training was expected to be directly associated with the growth of the system.

A clear relationship emerged:

> Those districts that demonstrated the most growth also offered major resources for training teachers and administrators during the implementation stage.

What Training Was Offered?

In the studied school districts, a combination of group training opportunities was made available. A major training approach was district-organized inservice on a variety of topics and levels, offered on a continuous basis. District or building-level microcomputer experts or computer coordinators provided additional help and information. Other resources available included user orientation, building inservice, classes for parents, classes at local universities, school clubs and user groups, and individual technical assistance by a computer coordinator/expert.

The history of training across the 12 school districts studied appeared to follow a distinct sequence. The first microcomputer users were typically self-taught. The adoption of the first few microcomputers was usually initiated by computer enthusiasts, often self-trained or intrinsically self-motivated

to seek training on their own. Their knowledge came from studying the hardware and software documentation and, in a few cases, from taking college courses. As new users became involved, the initial adopters provided individualized technical assistance to them. This informal tutoring and sharing of information established an atmosphere that encouraged others to become interested. This expansion, in turn, created a demand for more formal training, which could not be met through the efforts of an individual providing only one-to-one technical assistance.

Does Training Make a Difference?

During the early stages of microcomputer implementation in school districts, training did not appear to be a critical factor. This early phase was characterized by individualized technical assistance, orientation, and exploration. This form of instruction appeared to satisfy user needs as long as there were only a few microcomputers in the system. However, individualized technical assistance appeared to limit the rate of increase in users, as the computer enthusiast could only train one or two individuals at a time, therefore taking longer to reach all the users within the system. When the size of the system expanded beyond the first few microcomputers, the training needs of the increased number of users required more formal training to be established.

Furthermore, training must keep pace with the growth of the microcomputer system until most users are trained. In one district, the increase in the number of microcomputers was so rapid, it outstripped the training opportunities. Some teachers had received microcomputers even though they had not requested them; others reported that they did not know how to operate the units, and the microcomputers stood idle. Although the number of units had increased, the number of users did not, and no new applications were developed. Trained users are more efficient users: they can produce desired results in less time, using fewer resources.

Why Train?

The case studies demonstrated the importance of providing for training for microcomputer users. Organized, formal training opportunities enhance the use of microcomputers in several ways:

- Training fosters intelligent planning for additional microcomputer implementation. Although training may not be crucial in the initial planning stage, it can be useful for establishing interest and awareness of the system and for helping educators make informed decisions. Training increases local knowledge and expertise and helps to develop a resource pool of qualified personnel who can cope with potential problems that may arise.

- Training helps to meet increased information needs as programs and applications expand. When new uses of the microcomputer system are introduced, a trained staff facilitates a smoother transition. Training provides for continuity of the system, and helps to dispel anxiety and resistance to using microcomputers.

- Training offers opportunities for communication and support among users of the microcomputer system. The more knowledgeable the staff is, the more likely interaction and sharing between users will occur.

- Training facilitates efficiency of use and diversity of applications. Trained staff are more likely to use the system. The more comfortable and experienced users become with the system, the greater the probability that applications will be expanded and developed.

- Training helps ensure the longevity of the system. Without training for new users, the system is vulnerable to staff turnover.

Training Strategies

The most critical implementation strategy for microcomputer training is to plan for and formalize the training. Decisions regarding training policy, future training opportunities, and training resources are best addressed early, during the adoption and planning stages. At this point, planners can start to identify resources outside the school system (such as local computer clubs, vendors, colleges, and universities) to supplement district-sponsored training. Training requirements and specifications can also be solicited (such as conducting training sessions, identifying training needs and supplying materials) during the bid process when microcomputers are purchased. In addition, planners and trainers should identify and make use of local student and teacher enthusiasts and experts to conduct training sessions. For example, in one school district high school students taught a five-week evening course in computer literacy and BASIC programming as a fund-raising event for their computer club. The effort was so successful, they followed it with a course in advanced programming which was heavily attended by both teachers and residents in the district. An inservice strategy in an elementary school in this same district included a multiplier approach. Five students at each grade level were trained in how to operate the microcomputers. These students then trained more students until everyone in the school was able to use the microcomputers.

A variety of useful strategies and policies for organizing microcomputer inservice training was observed during the case studies. One district made a policy decision during the planning stages not to distribute microcomputers to the teachers until they had been trained sufficiently to use the microcomputer correctly. At another site, teachers were required to develop a plan demonstrating how they would use the computers in their classrooms as justification for receiving one. Other districts offered incentives (besides receiving a microcomputer) for attending inservice--such as tuition reimbursement, release time from class, or accumulated credits for additional salary increments.

What Should be the Content of Inservice Sessions?

The case studies also identified appropriate content for microcomputer inservices. "Quality" training in the districts was perceived by users to mean relevancy of training topics and compatability between the equipment used in training and that available in the schools. Programming (such as in BASIC) was not felt to be an appropriate objective for introductory inservice training. Most teachers were not interested in learning how to program; they simply wanted to be able to use the microcomputers. Effective content for introductory training as reported by teachers included:

- microcomputer operations, features, and hardware;
- loading and running CAI software;
- integrating computers with the curriculum;

- knowledge of available software and what it will do;
- how to review, select, and acquire additional software;
- saving programs and copying diskettes; and
- using the microcomputer creatively.

Effective content for later (advanced inservice) training included:

- programming (especially BASIC);
- authoring languages;
- word processing;
- computer-managed instruction (CMI); and
- other administrative applications.

Separate Training for Special Educators?

It was not necessary for school districts to develop and conduct separate training for regular and special educators. In all of the districts where special and regular education staff shared the microcomputers, special education teachers received the same inservice training as regular education teachers. One reason for this was that special education software was not readily available in these districts, so the same software was used in both regular and special education classes. Training of special educators should emphasize critical review and evaluation of software. However, special education incorporates some instructional aspects not generally required in regular education, such as the ability to adjust the courseware to suit the needs of the particular student--the core of individualized instruction. Yet all educators need to be made aware of software features that can be used to modify the presentation of lessons to students. Several features to look for in software, that have particular application in special education include:

- the ability to control the pacing of instruction in lessons;
- subroutines for monitoring, recording and reporting student progress;
- the ability to modify the level and nature of reinforcers presented to the student; and
- options for adjusting sequence of programs, time limits, mastery criteria, and item repitition, depending on particular needs of specific students.

In addition, some special education populations (e.g., severely handicapped) may require special hardware adaptations. Wherever specific adaptive devices or customized software is used, additional workshops on how to use this equipment may also be required. Discussion of these specific software and hardware features should be incorporated in all training programs. Both regular education students and those labeled handicapped can benefit from these generally sound instructional techniques. Special education administrators should make sure that these elements are presented in training that special educators receive.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN

No. 9

Microcomputers in Special Education

Microcomputers, Minicomputers, and Mainframes: How Do They Relate?

Three Types of Computers

School districts now use a variety of computers, for both instructional and administrative purposes. In addition to differences in brands, three types of computers may be distinguished, roughly according to their memory or storage size: microcomputers, minicomputers, and mainframes. The size distinctions are gradually being blurred, but in general microcomputers are the smallest of these three types (up to about 128K), minicomputers operate in a middle range (between 512K and 102K), and mainframes are the largest.

Besides being the smallest of the three types, microcomputers are usually used as independent, self-standing units. In contrast, the on-line terminals for minicomputers and mainframes are electronically connected ("hardwired") so that if the main computing unit is not operating, none of the terminals will operate either. Typically, a school district with a minicomputer or mainframe may have twenty or thirty terminals, located in different buildings, but all part of the same computer system. Microcomputers can be linked electronically into a similar configuration, but this is not how they have generally been used in school districts. Thus, one may consider microcomputers to follow a decentralized arrangement, and minicomputers and mainframes to follow centralized ones.

Given these differences in size and arrangement, a reasonable set of questions might be:

- Are all three types needed?
- If so, what functions are best performed by each? and
- Does collaboration or competition occur among those staffs responsible for each of the three types?

An ongoing study of microcomputer implementation in schools, emphasizing the uses of microcomputers in special education, examined these questions in twelve school districts, and the findings and their implications are reported below.

Uses of the Three Types, and Why

All twelve districts that were the subject of study had extensive experience in using microcomputers. The twelve districts were located in:

- Abingdon, Va.
- Boise City, Idaho
- Cheyenne, Wyo.
- Commack, N. Y.
- Hopkins, Minn.
- Lexington, Mass.
- Linden, Mich.
- Oakhurst, N. J.
- Pittsburg, Calif.
- Prescott, Ariz.
- Shelby, Ohio
- Tallulah, La.

Of these twelve, all also used minicomputers or mainframes. In some cases (e.g., Lexington), the minicomputers were owned by the district; in other cases (e.g., Linden, Pittsburg, Commack, and Shelby), mainframe service was purchased (leased) from some external organization, such as a commercial vendor, a regional educational agency (an intermediate unit or intermediate school district), or a state department of education. The larger the school district, the more likely it was to utilize a mainframe computer. In four cases (Boise, Cheyenne, Oakhurst, and Prescott), the district actually owned a mainframe.

Where a district had access to both microcomputers and either minicomputers or mainframes, a similar division of functions had emerged across districts. The microcomputers were generally used for instructional purposes, and the minicomputers or mainframes were generally used for a variety of administrative purposes, including: test scoring, attendance, student records, and grades, as well as payroll, budgeting, personnel, and accounting.

Two important shifts, however, also were occurring in the twelve districts. First, although the on-line terminals for minicomputers or mainframes had previously also been used for instructional purposes with computer science or computer programming classes, this application was being shifted over to microcomputers (e.g., Cheyenne, Oakhurst, and Tallulah). Second, microcomputers also were being increasingly used for administrative applications, such as the maintenance of rosters and lists, school-level test scoring, and budgeting (e.g., Oakhurst, Prescott, and Lexington), as well as Individualized Educational Plans (e.g., Tallulah and Prescott).

Both of these continuing transitions appeared to reflect the continuing growth of microcomputer systems and use in school districts, with some of this growth occurring at the expense of minicomputer and mainframe systems. At the same time, certain minicomputer or mainframe functions appeared to be permanently relegated to these larger computers--e.g., functions requiring the routine processing and enumeration of large amounts of data, as in grade reporting, payroll, and attendance functions.

Organizing to Use Microcomputers, Minicomputers, and Mainframes

Historically, computer usage in moderate to large school districts has been under the control of a data processing department. Such a department, located at the district level, would manage the administrative applications and also interact with the mathematics department in implementing computer science classes.

The findings from the twelve districts showed a different pattern of supervision over the microcomputers. In most of the districts, when microcomputers began to be used, the supervision of these smaller computers was by staff persons outside of the traditional data processing department. This pattern was found in four of the five districts that had data processing departments (Cheyenne, Lexington, Oakhurst, and Prescott), but not in the fifth case (Hopkins). The separation occurred in part because the early microcomputers were viewed more as showcase instructional equipment than as serious computational facilities. In addition, certain microcomputer projects were initiated by small groups of teachers, with project-specific funds (e.g., Abingdon and Shelby).

As a result of these different supervisory patterns, microcomputers have still tended to be managed by individuals outside of the main data processing departments; decisions about microcomputer additions and modifications also have followed a different path from decisions about minicomputer or mainframe facilities. In none of the districts was the microcomputer system initiated in collaboration with the minicomputer or mainframe system. Questions about coordination, if they occurred at all, only happened after a period of growth of the microcomputer system. In several cases (e.g., Boise, Linden, Shelby, and Oakhurst), the dual organizational roles--data processing vs. microcomputer supervision--continue on their independent paths.

In spite of the fact that microcomputers are gradually becoming more powerful computers with larger memories, their separate organizational supervision--vis-a-vis minicomputers or mainframes--may be desirable. To attempt coordination would entail administrative costs for planning and personnel resources, when such energies might better be put into the use of the computers themselves. At the same time, because of the different strengths of the three types of computers, they are not likely to become overly duplicative in their function.

In one case (Cheyenne), district staff became concerned about the lack of coordinated use of microcomputers and their minicomputer and mainframe counterparts. A moratorium on computer acquisition followed, with much disruption of the growth and nurturing of both small and large computer systems. Yet, the outcome of such attempted coordination has not clearly been an improvement over those districts that have made no such attempt.

Microcomputers, Minicomputers, and Mainframes: A Summary of Advantages and Disadvantages

Moderate to large school districts will probably continue to have both microcomputers and either minicomputers or mainframes. The three types of computers appear to have natural advantages and disadvantages that are complementary to one another.

Microcomputers allow users to be free of several disadvantages associated with minicomputers and mainframes: frequent "down" time of the entire system; disruption of instructional functions when critical administrative functions (e.g., payroll or grade reporting) need to be accomplished; high costs of leasing lines; and inflexibility of placement of terminals due to their being hardwired. In this sense, the microcomputers offer a decentralized and flexible system that can readily be tailored to changes in instructional needs and developments. The microcomputer system can become "dedicated" to instructional functions and serves most of them very well.

Minicomputers or mainframes allow users to process large quantities of routine data and records, far beyond the current capabilities of microcomputers, and with greater reliability. Moreover, if a district chooses to lease rather than purchase its minicomputers or mainframes (a choice that is not particularly relevant for microcomputers) the leasing arrangement may incorporate the upgrading of equipment to take advantage of improvements in the state of the technology. These improvements should reduce costs or reduce processing significantly.

Finally, the maintenance of a "dual" system--microcomputers on the one hand and minicomputers or mainframes on the other--also produces the most secure computer facility. It should be more difficult for students using microcomputers to access administrative records that are on a separate minicomputer or mainframe system, than the traditional arrangement where all functions were once performed within the same computer system. Bright students will always attempt to gain such illegal access, as highlighted in the movie "War Games," but the possibility of success will be much reduced.

Whether the maintenance of a dual computer system means the need for separate organizational supervision, however, is not clear. An experienced district, with sufficient knowledge of microcomputers, minicomputers, and mainframes, may very well move toward an integrated management and supervision of the entire array of computer facilities. However, completely independent organizational units--one dealing with microcomputers and the other with minicomputers or mainframes--seem to function equally efficiently. Thus, school districts may consider themselves as having a choice on this important organizational matter, recognizing that good examples of both types of arrangements exist.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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MICROSPED
INFORMATION BULLETIN

No. **10**

Microcomputers in Special Education

Supervising Microcomputers in the Schools: From the Top Down-- Or From the Bottom Up?

Microcomputers can be purchased centrally by school district administration, to be placed in computer "labs" or distributed to classrooms. Alternatively, microcomputers can also be acquired by individual teachers or principals for use in particular schools or classrooms. In addition, microcomputers can also be adopted at an intermediate level--e.g., by an educational department, such as special education or science.

This range of choices is one of the features of microcomputers that distinguishes them from earlier and larger computing systems, such as mainframe or mini-computers. Systems based on the larger computers did not accommodate "decentralization." However, because each microcomputer is a self-standing unit, it can be adopted for individual use, independent of other computers that are present in the school district. This option offers a variety of management alternatives and, therefore, poses questions about the relative effects of different supervision patterns regarding microcomputers:

- Is centralized (i.e., district control) management more or less advantageous than a decentralized (i.e., classroom or building) approach?
- What are the benefits and problems associated with different microcomputer-management patterns?

These questions represent an issue, centralization-decentralization, that was examined in case studies of 12 school districts where microcomputers have been used in special education. This issue (the last) of MICROSPED Information Bulletin reports the findings in this area.

Definition of Supervisory Patterns.

To examine this issue, several activities were documented in each school district:

- The decision to purchase the microcomputers;
- The way in which microcomputers were allocated to classrooms or other locations;
- The decision-making pattern for reviewing, selecting, and distributing software; and
- The arrangements, if any, for training microcomputer users.

The more these decisions were in the hands of district administrators, the more the microcomputer system was regarded as being centralized; the more these decisions were left to principals and teachers, the more the systems was regarded as being decentralized.

Classification of the microcomputer system was not always an easy task. In some school districts, for example, the supervisory pattern changed over time. In other cases, the participants in decision-making included both district-level and school-level staff. In all of these instances, an arbitrary decision was made, based upon the degree to which centralized or decentralized staff participated in key decisions.

What Patterns Were Found?

Neither centralization nor decentralization dominated the supervision of microcomputers in the 12 cases that were studied. Six systems were characterized as centralized; four as decentralized; and two had shifted over time--one from centralization to decentralization, and one from decentralization to centralization.

The typical centralized pattern occurred when district-level administrators played an early role in adoption and management of the microcomputers. A decentralized pattern emerged when district-level staff did not participate in early implementation, or were only involved in a funding or approval capacity. In decentralized systems, interest and expertise were clearly localized at the school building level--with teachers and principals.

Did the Pattern Make a Difference?

Neither pattern seemed to have clear advantages. There were benefits and problems associated with each. The numbers of microcomputers and their users increased under both types of supervisory models. Difficulties also occurred under both patterns and, in many cases, seemed to be associated with the management approach.

It was found that excessive centralization could lead to allocation of mirocomputers that disregarded the needs or interests of the intended users. Under such circumstances, the microcomputers were underutilized: they "gathered dust" in storage rooms and closets. Teachers complained that they had been "assigned" their microcomputer--they hadn't requested it and didn't know what to do with it once they received it. In one school district, the initially-planned, centralized system had proven a complete failure. Subsequently, teachers and building-level coordinators acquired the microcomputers and established successful decentralized uses.

In decentralized systems, a different set of pitfalls was encountered. Growth of the systems was sporadic; isolated microcomputer applications were vulnerable to staff turnover; the presence of different brands of equipment led to problems of "incompatibility"; independent users engaged in redundant and inefficient software development and acquisition. It was

found that excessive problems in a decentralized system could lead administrators to "clamp down" on microcomputer implementation. In one district experiencing such difficulties (incompatible hardware and software, inter-school squabbles for control of available resources), the Superintendent instituted a moratorium on the purchase of any new microcomputer equipment.

An Alternative Approach: the Mixed Model.

Many of the school districts that were studied demonstrated highly successful microcomputer implementation:

- Numbers of microcomputers and available software increased greatly from year to year;
- Microcomputer applications diversified, expanded, and became more sophisticated;
- Numbers of users (staff and students) increased and their skills and knowledge of microcomputer operation and utilization were enhanced.

In every one of these cases, the supervision pattern included both centralized and decentralized participation: administrators and teachers co-operated in management and implementation decisions. When persons with both administrative and teaching skills collaborate during implementation, the combination can be quite potent. Teachers can relate the microcomputers to actual curricular objectives and classroom needs. They can identify relevant training and technical assistance requirements, and specify the types of software and hardware that are needed. District-level administrators can help coordinate the system and ensure that resources are made available for purchases of equipment and software, and for user training. Administrative support is also crucial to equitable assignment, allocation, and scheduling of microcomputers.

How Can Teachers and Administrators Work Together to Manage Microcomputer Systems?

The most effective microcomputer systems had two key characteristics:

- The central coordinating group included both teaching and administrative staff and was limited in size; and
- Roles and responsibilities for managing the microcomputers were clearly defined and designated.

Regarding the first of these factors, it was found that there was a limit to the size of the group of personnel who could work together effectively to supervise microcomputer implementation. A small committee, with four to six individuals, seemed to provide an effective working group. Beyond this size, groups seemed to suffer serious communication and concensus

problems that prevented efficient decision-making. As an extreme example, one school district had a microcomputer management committee with a representative from each school. There were over fifty people on the committee. Such a committee may have served a "political" function, allowing staff to air their opinions and concerns, but it served no useful purpose from a management perspective. In contrast, the groups that had two-or-three administrators and two-or-three teachers or other building- level staff, proved to be efficient and responsive to administrative and instructional microcomputer objectives.

As for the second key feature, roles and responsibilities, the more successfuly groups designated management functions with greater clarity. For example, one person often served a key role for identification, acquisition, and distributing of software. Another person supervised the inservice training. Another assumed responsibility for developing and coordinating administrative or instructional applications. Each and every member of the group could participate in decisions across these areas, but one person ensured that the activities in each area were coordinated and implemented.

Regarding this last point, another feature documented in the case studies (and analyzed in an earlier Bulletin, No. 7) bears repeating here: the importance of centralized and decentralized coordination. Emergence of "coordinator" positions was a characteristic of growth in microcomputer systems. In some cases, the coordinators were formally designed by administration; in others, the early microcomputer adopters were recognized by new users as key technical support people within the schools. In a few school districts--particularly the larger ones with the more advanced microcomputer systems--formal recognition of coordinators emerged at both the district and the building levels. Coordination was essential at the district level to foster efficient and fair allocation of resources. Coordination was equally important at the school level to provide direct, responsive, and immediate assistance to teachers.

In summary, then, the patterns of supervision documented in the case studies suggest that school districts should try to avoid the pitfalls of overly centralized and decentralized situations. The most successful systems incorporated both district and building level participation in implementation decisions. Coordination requires a small group of administrators and teachers at the district level to be efficient, and technical experts within each school to assist other users.

Editor's Note. This is the last of ten issues in this series. The full set of MICROSPED Information Bulletins can be obtained from the Regional Resource Centers and from the ERIC Clearinghouse on the Handicapped and Gifted, CEC, Reston, Virginia.

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Project Director: Tom V. Hanley, SRA
Principal Investigator: Robert K. Yin, COSMOS
Dissemination Specialist: Laura S. Clark, SRA
Case Study Specialist: J. Lynne White, COSMOS
Editor: Margaret R. Brandis, SRA

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